BOOK REVIEWS

Electricity from Renewable Resources – Status, Prospects, and Impediments. **National Academy of Sciences, National Academy of Engineering, and The National Research Council. The National Academies Press, Washington, D. C., 20001, www.nap.edu 304 p. Price $56.95 USD. ISBN: 0-0309-0xxxx-x (Reviewed from prepublication copy-subject to further editorial corrections.) Accessed 2 Oct 2009: http://www.nap.edu/catalog.php?record_id=12619**

The subject of non-hydroelectric renewable energy has recently received high media and political interest. Developed by a distinguished panel of experts, this report surveys a number of renewable energy sources over a long planning horizon. Seven chapters and six appendices cover a wide variety of concerns related to renewable means to generate energy to help alleviate America's present dependence on fossil fuels. The authors consider issues associated with the entire life cycle of ramping up to alternative forms of energy generation.

The first chapter examines the current status of renewable electricity generation which is sparsely used (currently 2.5% of the USA's total energy generation) due to its higher relative cost compared with non-renewable sources. Renewable is a desirable form of energy generation because it reduces our dependence on other countries, provides less pollution, and has other environmental advantages. If carefully developed, renewable energy may last for an indefinite time. Over the last few decades the United States of America (USA) has become increasingly dependent on the fossil fuels as the primary source of energy. Thus a significant time delay or ramp up time exists before a larger percentage of our energy dependence can be shared economically and practically by these alternative methods.

Presently in the USA, electricity demand grows at a rate of one percent a year. Also in Chapter 1, the policies of the states and federal government are discussed on how they influence this type of remediation. Policy (tax incentives) and regulation risk are important factors to consider. Chapter 2 introduces a number of resource bases (energy sources) that could be used to produce renewable electricity with wind, solar, and geothermal as the most seriously considered. The practicality of a particular resource is predicated on (1) its availability, (2) the ease with which the technology can capture the energy, (3) ease of transportation of the energy from place to place, with (4) the initial capitalization and total life cycle costs to obtain the energy. Chapter 3 addresses the different technologies that can extract renewable energy. For example, solar power can be realized via a photovoltaic cell or by concentration with parabolic mirrors more efficiently gleaning the solar power from the environment. Chapter 3 also addresses smart grids and advanced meters which tailor the needs of the consumer to the available sources of power. Other energy generation methods are introduced such as hydrokinetic (wave or tide power, undersea currents, and salt gradients), biomass and chemical.

Chapter 4 reviews the economics of the extraction process including the projected increases in costs over time (in ramping up a technology) as well as possible depletion of the resource base. Chapter 5 reflects on the environmental impacts of the different technologies. It is interesting to note that the wind powered turbines may actually alter climate, and factors of this type are taken into account. Chapter 6 considers the important issue of deployment of renewable energy sources. For example, having wind turbines on floating off-shore platforms has the issue of practically bringing the electricity generated to the power grid and how this affects the cost, security, intermittency, reliability, and other factors of this intricate type of electricity generation. In chapter 7, a number of "what if" scenarios are examined. These scenarios consider how to slowly upgrade the level of some of the present renewable energy sources (wind, solar, geothermal) and how much start-up time, development, and changes in cost would affect the overall solution over various periods (short term, midterm and long term, beyond 2035). For example, one of the scenarios includes remediation of our current strong dependence on fossil fuels by wind power with the issues of manufacturing, availability of materials, land use, integration into the present power grids, environmental concerns, and possible lack of social acceptance. The environment impact of each scenario also is examined.

The six appendices discuss background materials including briefing materials by the expert panel that wrote this manuscript. The 76 figures provide evidence through many graphs with analysis of related topics.

The panel that developed this book included well-known experts in their fields. What is special about their approach is that many supplementary forms are considered of possible renewable energy generation, even if they may not be practical today. Thus the report provides a totally integrated approach, considering many new aspects of the overall energy generation cycle, including environmental and social concerns.

The strengths of the book include many new viewpoints of possible procedures to help mitigate our present dependence on fossil fuels. Some of the weaknesses include its long and detailed analysis in Chapter 7, which would be more useful for the specialist. In this last chapter, involving possible integrated scenarios, it is limited in its choices and each solution considered may not be directly applicable to the present state of affairs. In some of the figures, more information on the meaning of the y axis variables would have been more helpful. Some chapters were still missing titles and some figures were still incomplete (awaiting copyright permission). No index of terms was provided.

This book is valuable for the specialist who would like to get an improved understanding of the many different alternative or renewable energy generation methods. Possibly a person or business interest in these ventures would find some value with these materials. The scenarios in Chapter 7 give several new perspectives on possible solutions but are limited. For companies considering alternative ways to deal with the cost of energy over the next decade or so, they may consider more seriously investing in solar, wind, or geothermal power that give rise to the "green energy" paradigm which is now a politically correct viewpoint worldwide. Also, home owners in Ohio may see more long term benefits in an investment of solar, wind or geothermal means to augment their contemporary sources of power for their own personal use.

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Strengthening Forensic Science in the United States: A Path Forward. **Committee on Identifying the Needs of the Forensic Science Community, National Research Council of the National Academies. The National Academies Press, Washington, D.C. 2009, 352 pages. $32.36. ISBN-13: 978-0-309-13135-9. Accessed August 19, 2009: http://www.nap.edu/catalog.php?record_id=12589**

The Congress, recognizing that forensic science practiced and utilized in the United States needs significant improvement, directed the National Academy of Science to create an independent Forensic Science Committee to undertake a study that results in this report. The report begins with descriptions of the current forensic science system, the use of forensic science evidences in litigations, and the science and forensic science disciplines. It addresses areas for improvement to achieve a more rigorous and robust infrastructure, with national standards

and best practices, education and training. The Committee then addresses in the last three chapters special issues in medical-legal death investigation, automated fingerprint identification systems (AFIS), and the importance of forensic science disciplines to homeland security.

The report consists of introductory materials (Members of the Committee on Identifying the Needs of the Forensic Science Community, the Committee on Science, Technology, and Law, and the Committee on Applied and Theoretical Statistics, Acknowledgment, and Table of Contents), a summary, eleven chapters, and two appendices.

The eleven chapters may be divided into three groups:

(1) Chapter 1 provides general information on crime and investigation of crime and a detail description of the immense pressures on the forensic science system in nine areas.

(2) Chapters 3, 4, and 5 have conclusions but no recommendations. Chapter 3 is concerned with the legal issues on standards and rules of evidences and some examples of judicial dispositions of questions relating to forensic science evidence. Chapter 4 details the principles of science and interpreting scientific data and sources of bias in the interpretation. Chapter 5, the longest of the three, describes the analysis and assessment of the analysis of the following: biological evidence, controlled substances, friction ridges (finger, palm, or sole prints), other patterns/impressions, tool mark and firearms, hair, fiber, questioned document, paint and coating, explosive and fire debris, teeth, bloodstain pattern, digital and multimedia.

(3) Chapters 2, 6, 7, 8, 9, 10, and 11 have conclusions and recommendations. The following description of each recommendation is over-simplified. Readers should consult the original report for the complete recommendations. Chapter 2 describes the fragmented forensic science community and major problems. The Committee's first recommendation is the creation of a National Institute of Forensic Science (NIFS) that will focus on nine areas to provide an integrated governance of the diverse forensic science community and to promote the development of forensic science into a mature field of multidisciplinary research and practice. The aims of chapter 2 are further developed in chapters 6, 7, and 8. Chapter 6 concerns improving methods, practice, and performance in Forensic Science with recommendations 2, 3, 4, and 5. Recommendation 2: NIFS should establish standard terminology in reporting and testifying and model laboratory report for results of different forensic sciences. Recommendation 3: NIFS should fund research to establish the scientific bases demonstrating the validity of forensic methods and development of automated techniques. Recommendation 4: NIFS should fund state and local jurisdictions to remove all public forensic laboratories and facilities from the administrative control of the law enforcement agencies or prosecutor's offices. Recommendation 5: NIFS should encourage research on human observer bias and sources of human error in forensic examinations. Chapter 7 concerns strengthening oversight of forensic science practice with recommendations 6, 7, 8, and 9. Recommendation 6: NIFS should work with other entities to develop and establish "best practices" for forensic examinations. Recommendation 7: Laboratory accreditation and individual certification of forensic science professional should be mandatory. Recommendation 8: Forensic laboratories should establish routine quality assurance and quality control procedures. Recommendation 9: NIFS should establish a national code of ethics for all forensic science disciplines. Chapter 8 concerns education and training in forensic science with recommendation 10: NIFS should improve and develop graduate education programs in forensic science and to support continuing legal education programs. Chapters 9, 10, and 11 address the needs of medical examiners and coroner, problems in automated fingerprint identification system, and relationship between homeland security and forensic science with three recommendations. Recommendation 11: NIFS should improve medico-legal death investigation. Recommendation 12: NIFS should work on achieving nationwide fingerprint data interoperability. Recommendation 13: NISF should prepare in conjunction with CDC and FBI, forensic scientists and crime scene investigators for their potential roles in managing and analyzing evidence from events that affect homeland security.

The Summary gives a succinct report on the 16 issues covered during the Committee's hearings and deliberations, important observations in eight areas, and findings of a fragmented system, symptoms and cures, and the 13 recommendations given in the various chapters. The appendices give biographical information on committee members and staff and provide the committee meeting agendas.

This report certainly is the most comprehensive examination of the forensic science community and practices in the United States, with very detailed documentation. The 13 recommendations are ambitious but reasonable solutions to the problems but will face different degrees of challenges in their realization. Page nine of the Summary has a note on "Political Realities" that mentioned "... the committee remained mindful of the fact that Congress cannot directly fix all of the deficiencies in the forensic community. ... the committee exercised caution before drawing conclusions and avoided being too prescriptive in its recommendations. It also recognized that, given the complexity of the issues and the political realities that may pose obstacles to change, some recommendations will have to be implemented creatively and over time in order to be effective." Recommendation 4 may be one such recommendation. Crime scene investigator (CSI) training and employment probably deserve more consideration. A case is only as good as what evidence the CSI collects. Another issue not thoroughly examined by the Committee was the effect of starting salary of forensic scientists on career choices by students educated in forensic science.

The report should interest the forensic science, law, and education communities, who will be directly affected if the recommendations were implemented. The report is a better primer for the general public, students, and writers interested in forensic investigation and trial proceedings than the CSI and court programs on TV.

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Liquid Transportation Fuels from Coal and Biomass: Technological Status, Costs, and Environmental Impacts. **National Academy of Sciences, National Academy of Engineering, and The National Research Council.The National Academies Press, Washington, DC. 2009. 322 p. $56.95. ISBN 978-0-309-13879-6.**

The reality of a domestically produced supply of liquid transportation fuels can only be achieved through significant advances in, and a commitment to, an array of technologies that address immediate needs and utilize available resources while considering a future vision of transportation in light of sustainability practices. While the nation develops alternative, more sustainable transportation technologies, the two primary domestic resources that are available to supply current liquid fuel demands are coal and biomass. This review by the National Academies does an admirable job of identifying and evaluating the most promising options and offers valuable recommendations for pursuing appropriate pathways to attain energy independence in the liquid transportation fuel market. The panel members offer 20 findings

and 15 recommendations in the review summary to U.S policy makers, which are also invaluable to key industrial stakeholders, the scientific community, and the American public.

After a brief overview of the current U.S. demand for liquid transportation fuels, the National Academies panel members devote a significant percentage of their efforts identifying appropriate biomass sources, calculating the quantities of sustainably generated biomass, evaluating life-cycle costs and environmental impacts of producing this feedstock, and suggesting research and development needs to increase production quantities and efficiencies in a sustainable manner. It is estimated that 164 million dry tons of cellulosic feedstock could be harvested from 24 million acres (6.8 tons/acre/year) of U.S. Conservation Reserve Program land by the year 2020 if dedicated to fuel-crop production (e.g. switchgrass, mixed prairie grasses, Miscanthus). When added to the estimates for other potential biomass feedstocks including corn stover, wheat and straw grass, hay, woody residues, animal manure, and municipal solid waste, nearly 550 million dry tons of lignocellulosic feedstock could potentially be sustainably produced for biofuels by 2020. However, as an advocate for algal biomass as a potential fuel feedstock, the absence of any discussion of the potential to develop microalgae farming was disappointing. The fact that algae cultivation meets the fundamental principles set by the panel, has a conservatively estimated yield of 50 to 65 tons/acre/year, and is highly likely to by fully developed by 2020 leaves this reviewer to wonder why it was not given equal consideration.

A comprehensive review of the biochemical conversion of biomass to liquid transportation fuels is inhibited by the fact that ethanol has been elevated to a status where it stands unchallenged by the establishment as the fuel product of choice. While brief mention is given in the review to alternative choices such as biobutanol and algae-derived fuels, the purposeful decision to declare cellulosic ethanol as the only viable choice over the next decade dominates the chapter on biochemical conversion. With this in mind, the panel is comprehensive in its evaluation of the current status of technologies to convert lignocellulosic biomass to ethanol. For audience members with specific interest in economic evaluations for, and environmental release of carbon from ethanol plants, a highlight of the publication is the modeling of the cellulosic ethanol process using SuperPro Designer® afforded in Appendix I. While sufficiently simplified for ease of understanding by the majority of readers, those with an engineering background will be especially appreciative of the data and schematics provided detailing the conversion processes.

The review of thermochemical conversion of coal and biomass provides a thorough understanding of the critical issues that need to be addressed in order to bring these technologies to market in the next decade. Of particular importance are the life-cycle greenhouse gas (GHG) emissions (carbon footprint) and scaling impacts on capital and operating costs for two primary processes – Fischer-Tropsch (FT) synthesis and Methanol-to-Gasoline (MTG). Due to the potential for utilizing a fossil feedstock (coal), the potential for increased carbon release to the atmosphere is a critical parameter to determine the commercialization potential of coal-to-liquid (CTL) transportation fuels. Based primarily on the recent interest in global climate change, released carbon from CTL plants will have a significant financial liability through a probable carbon tax or cap-and-trade policy, or the need for carbon capture and storage (CCS), which potentially eliminates CTL technologies from commercial viability.

This is contrasted with biomass-to-liquid (BTL) plants which alleviate the carbon concerns, but at the expense of increased unit cost due to smaller BTL plants, regional feedstock availability and handling limitations, and a distinct lack of demonstration-scale plants providing commercial experience. The review admirably advocates for the coal-and-biomass-to-liquid (CBTL) option as a compromise to offer full-scale liquid transportation fuel capacity with the environmental benefits of a carbon footprint comparable to current fuels (without CCS) or with a potential for significant improvement over petroleum-based fuels (with CCS). This chapter in the review also includes a substantial evaluation of the cost and performance metrics for CTL, BTL, and CBTL technologies with and without CCS for both FT and MTG processes, as well as a brief introduction to the concepts of polygeneration (multiple product streams including liquid fuels) and direct liquefaction.

The final five chapters offer a brief evaluation of topics including distribution and transportation issues, market potentials and penetration estimates, as well as overall comparisons of costs, GHG emissions, and potential fuel supplies. Overall conclusions and recommendations include two findings and eight recommendations, while five key challenges to commercial deployment are identified. The review concludes with a very brief discussion of other alternative fuel options, including compressed natural gas, alternative diesel, methanol, dimethyl ether, and hydrogen.

The National Academies technological and economic review of domestic liquid transportation fuel options is a comprehensive evaluation of the current status and immediate needs to bring sustainable security to the U.S. transportation sector. While clearly favoring cellulosic ethanol as a near-term priority and failing to include the potential for algae-based biofuels, the review does an outstanding job of identifying high-potential technologies that deserve the financial support of the federal government and key industrial stakeholders. This review will serve to inform government representatives, corporate stakeholders with interests in the energy sector, academics engaged in sustainable energy research and education, as well as the general public on critical issues regarding the production of liquid transportation fuels from domestic resources.

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